SW06 Shallow Water Acoustics Experiment

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LONG TERM GOALS

The long term goal of our shallow water acoustics work is to understand the nature of low frequency (10-1500 Hz) acoustic propagation and scattering in shallow water when strong oceanic variability in the form of fronts, eddies, boundary layers, and internal waves is present.

OBJECTIVES

Our primary objective this year was to continue the analysis of the data set collected by the SW06 experiment, and model it with theory and numerical models. A secondary objective was to continue some of our other ongoing analyses in shallow water acoustics.

APPROACH

In performing the data analysis, we have concentrated in the past year on disseminating reduced data to various investigators, maintaining a web site for the project, and publishing the first distillations and analyses of the data.

WORK COMPLETED/ACCOMPLISHMENTS

Our main accomplishment was the publication of a number of articles, in collaboration with various other SW06 PI's, in a JASA-EL Special Issue in September, 2008. We also worked on a number of other shallow water acoustics topics this past year, in addition to SW06. These were: 1) ducting of acoustic energy between internal waves in shallow water, 2) a book chapter on geoacoustic inversion techniques, 3) studies of the uncertainty in bottom inversions due to water column uncertainty, 4) a book chapter on nonlinear internal waves and acoustics, and 5) our book on shallow water acoustics.

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RESULTS

There are a large number of results that are coming out from our work, both on SW06 and other shallow water projects. Some of the most intriguing to us are: 1) developing a formalism (data

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14. ABSTRACT
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15. SUBJECT TERMS

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nullspace projection) that allows us to project “noisy” data out of a data set, and thus use cleaner data for inversions, source localization, etc. 2) the continuing analysis of two data sets that will allow us to see directly the azimuthal dependence of propagation (i.e. TL) in a shallow water environment, 3) development of 3-D acoustic theory and computer models that will allow us to explain the arrival fluctuations seen in SW signals, e.g. in travel time, intensity, and apparent direction. An example of effects we are working on is shown in Figure 1.

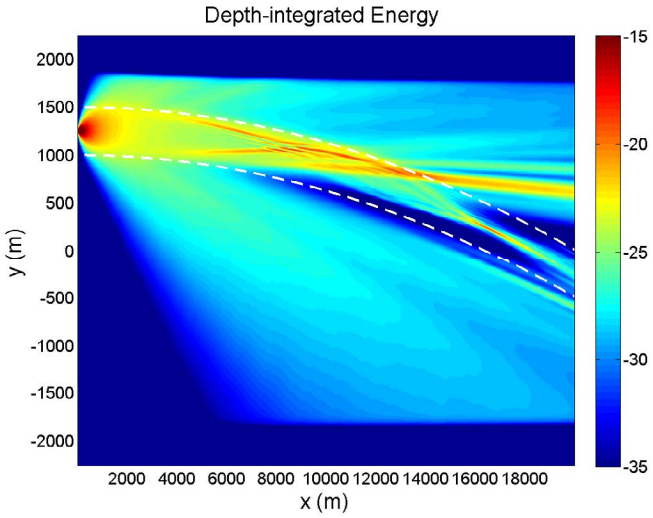

Figure 1. 200 Hz sound modes propagating through a curved internal wave. Modes one and two escape the duct, though dispersed, whereas modes three and four are trapped within the “horizontal waveguide” created by the internal wave.

IMPACT/APPLICATIONS

The impact of our experiment should be: 1) an increased understanding of the propagation of sound through complicated, 3-D coastal oceanography and 2) a better understanding of how to incorporate “uncertainty” in the ocean state into sonar performance measures.

TRANSITIONS

One eventual transition of our data will be to ONR’s Uncertainty DRI program, where the interest is in “the error bars” in ocean acoustic field and system performance prediction.

RELATED PROJECTS

The SW06 experiment also had an AWACS component, stressing the use of acoustics on AUV’s and gliders, and also adaptive sampling. The ongoing QPE experiment, stressing acoustic and environmental Uncertainty in a coastal environment, is also related.

PUBLICATIONS

[1] J.M. Collis, T.F. Duda, J.F. Lynch, and H.A. DeFerrari, "Observed limiting cases of horizontal field coherence and array performance in a time-varying internal wavefield," *JASA-EL* , 124 (3), EL97-EL103 (2008).

[2] B. Katsnelson, V. Grigorev, J.F. Lynch, and D. Tang, "Intensity fluctuations of mid-frequency sound signals passing through moving nonlinear internal waves," *JASA-EL*, 124(3), EL78-84 (2008).

[3] J.Luo, M. Badiey, E.A. Karjadi, B. Katsnelson, A. Tskhoidze, J.F. Lynch, and J.N. Moum, "Observation of sound focusing and defocusing due to propagating nonlinear internal waves,", *JASA-EL* 124 (3), EL66-EL72 (2008).

[4] G.R. Potty, J.H. Miller, P.S. Wilson, J. F. Lynch, and A. Newhall, "Geoacoustic inversion using combustive sound source signals," *JASA-EL* 124 (3), EL146-EL150 (2008).

[5] H. DeFerrari, J. Lynch and A. Newhall, "Temporal coherence of mode arrivals," *JASA-EL* 124(3), EL 104-EL109 (2008)

[6] J. Lynch and D.J.Tang, "Overview of Shallow Water 2006 JASA-EL Special Issue Papers," *JASA-EL* 124(3), EL 63-EL65 (2008).

[7] S.D.Rajan, G.V. Frisk, K.M. Becker, J.F. Lynch, G. Potty, and J.H. Miller, "Modal inverse techniques for inferring geoacoustic properties in shallow water." Book Chapter in: "Important elements in geoacoustic inversion, signal processing, and reverberation in underwater acoustics," A. Tolstoy, Ed. Pp. 165-234, Research Signpost. (2008).